FURTHER DETAILS REGARDING MAIN TOPICS OF PROGRAMME No. 12/2016 (Item No. 12)

LECTURER IN ELECTRICAL AND ELECTRONICS ENGINEERING (GOVERNMENT POLYTECHNICS)

TECHNICAL EDUCATION DEPARTMENT

(CATEGORY No.187/2016)

Technical Mathematics

I. Matrices – Identification of Matrices, matrix operations, adjoint and inverse.

II. Determinants – Evaluation of second and third order, minors and cofactors, solutions of simultaneous linear equation in three unknown using Cramer's rule.

III. Binomial Series – Expansions using Binomial theorem.

IV. Trigonometric functions – Signs of functions in each quadrant. Trigonometric values of angles, properties of trigonometric functions, applications of the identities sin (A ± B), cos (A ± B) and tan (A ± B).

V. Coordinate geometry – Equations to a straight line – slope-intercept form, intercept form, Angle between two lines, condition for two lines to be perpendicular, parallel.

VI. Differentiation – Limits and continuity, derivatives of functions, equation to tangents and normals. Maxima and minima of functions of one variable.

VII. Integration of functions – Integration of different types of functions.

VIII. Applications of integration – Area bounded by a curve and X or Y axis, solutions of differential equations using the method of variable separable, solutions of linear differential equations of first order.

Basic Civil Engineering

Materials: Brick – varieties and strength, characteristics of good brick. Cement – varieties and grade of cement and its uses. Steel – types of steel for reinforcement bars, steel structural sections. Aggregates – types & requirements of good aggregates. Concrete – grades of concrete as per IS code, water cement ratio. Workability, mixing, batching, compaction and curing.

Construction: Parts of building – foundation – types of foundations – spread footing, isolated footing, combined footing, Raft, pile and well foundations. Masonry – types rubble masonry, brick masonry, English bond and Flemish bond. (One brick wall).

Surveying: Chain surveying – principles, instruments, ranging, and chaining survey lines, field work and field book, selection of survey stations, units of land area.

Levelling: Levelling instruments, different types, bench mark, reduced level of points, booking of field notes, reduction of levels by height of collimation method (simple problem). Modern survey – instruments – Total station, Electronics theodolite, Distomat.

Basic Mechanical Engineering

The importance of IC Engines: Definition, classification – two stroke engines, four stroke engines, working of two stroke engines and four stroke engines with the help of line sketches, comparison between two stroke and four stroke engines, comparison between petrol and diesel engines, function of fly wheel, clutch, gearbox, propeller shaft and differential in power transmission, explain with sketch the working of differential, briefly explain power transmission of 4 wheel vehicle with line diagram.

The importance of Power Plants: Introduction, classification of power plants – working of hydroelectric power plant with schematic sketches – working of thermal (Steam and Diesel) power plant with schematic sketches – working of nuclear power plant with schematic sketches.

Basic Electrical Engineering

Review with discussion of electric current, potential difference, power, EMF, resistance and its laws, Ohms law and series parallel circuit, electromagnetism, generation of AC and DC supply.

Idea of Basic electrical circuit: Electrical supply and load and its functioning, division of voltage and current in a parallel and series circuit – simple problems, units of power and energy, solution of DC circuit with calculation of energy consumption in an installation.

Circuit parameters: Resistance, Capacitance and inductance. AC circuit with R, L, C. Simple solution of typical AC circuit with resistance, impedance, power and power factor.

Electrical circuit of an installation: Earthing, lightning protection.

Essentials of Electronics Engineering

Active and passive devices – review only. LED – working, applications, comparison of LED lighting and CFL lighting. Full wave rectifier – diagram and explanation, 5 V power supply – with bridge rectifier and 7805. SMPS – block diagram and advantages. Integrated circuits. SMDs – advantages. Static electricity – precautions in handling electronic circuits.

Switches: ON / OFF, push to ON, push to OFF, push to ON / OFF, SPST, SPDT, DPDT. Working and application of limit switches, proximity switches, relays.

Microcontrollers: Simple block diagram of 8 bit microcontrollers – application.

Mobile technology: CDMA and GSM. Compare – 2G and 3G technologies.

Inverter & UPS: Block diagram. Compare – inverter and UPS. Online and off line UPS – differentiate. Battery selection for UPS and inverter.

E-waste: Health hazards of e-waste.

ELECTRICAL AND ELECTRONICS ENGINEERING

Module I : Electronic Circuits and Field Theory

Node and Mesh analysis, transient response of dc and ac networks, sinusoidal steady state analysis, resonance, two port network, independent and dependent voltage and current sources, coupled circuits, tuned coupled circuits, Network theorems – superposition, reciprocity, substitution, compensation, Thevenin, Norton, Millman, Telligen and Maximum power transfer theorems. Analysis of Three phase circuits, symmetrical components, graph theory – analysis of network using cut-set and tri-set. Filters constant – K low pass, high pass and band-pass filters – m derived, low pass, high pass and band pass filters.

Gauss's law and applications, electric field, electric potential, electric field lines, electric dipoles, potential gradient, conductors, dielectrics, capacitance, polarisation, method of images, dielectric strength, Biot-Savart's law, Ampere's circuital law, Stoke's theorem, scalar and vector magnetic potential, force between current carrying wires, Maxwell's equation – wave equation – Poynting theorem.

Module II : Electrical Machines

Single phase Transformer – leakage reactance, equivalent circuit, losses and efficiency, voltage regulation, OC, SC and Sumpner's tests, Distribution transformer, all day efficiency, autotransformer – saving of copper three phase transformer – connections, vector groupings, parallel operation.

DC machines – Types of excitation, constructional features.

DC generator – Emf equation, armature reaction & commutation, characteristics, voltage build up, applications.

DC motor – Torque equation, characteristics of shunt, series & compound motors, necessity & types of starters, speed control, applications, Swinburne's test, Hopkinson's test.

Synchronous machines: - constructional features, winding factor.
Alternator: Types, synchronous reactance, voltage regulation, emf and mmf methods, short circuit ratio, Two reaction theory, alternator on infinite bus, power angle characteristics, parallel operation, effect of variation of power input & excitation.
Synchronous motor – principle of operation, methods of starting, hunting & its reduction.
Three phase induction motor – constructional features, types, slip rotor frequency, power flow, Torque – slip curve, effect of rotor resistance, starting methods, speed control.
Single phase induction motor – double field revolving theory, starting methods.
Basic concepts of ac and dc drives.

Module III : Power Systems

Conventional and non-conventional systems of power generation, power plant economics, load factor, demand factor, diversity factor, Transmission line parameters – T and ∏ models GMD and GMR, ABCD constants, overload lines – arrangement of conductors – sag, economic span, choice of transmission voltage, types of insulators, string efficiency, distribution systems – types, comparison of DC and AC single phase and 3 phase systems.
One line diagrams per unit quantities, formation of Y bus and Ƶ Bus. Load flow studies – Gauss – Seidal, Newton Raphson and Fast decoupled load flow methods.
Faults on power systems – LG, LL, LLG and 3 phase faults. Fault analysis using Ƶ Bus.
Power system stability, steady state transient and dynamic stability, equal area criterion, swing curve.
Protective relays: types and operation, protective zones, different protection schemes.
Circuit Breakers – types and operations, selection of circuit breakers, calculation of fault KVA, protection against lightning and overvoltages.
Electric traction – speed – time curves - mechanics
Electric heating – Advantages, types and applications.

Principles of PMMC, moving iron, and electrodynamometer type instruments, error analysis, measurement of voltage, current, power energy and power factor, induction type watt-hour meter, DC bridges and AC bridges, magnetic measurements, Instrument transformers, digital voltmeters and multimeters, digital measurements of frequency, phase angle, time interval. Electronic energy meter, high voltage measurements, oscilloscopes, Data acquisition systems, Transducers for temperature, flow and pressure.

Module IV : Control Systems

Open loop and closed loop system: Transfer function, force-voltage & force-current analogy, block diagrams, signal flow graphs – Mason's gain formula – characteristic equation, time domain analysis – transient & steady state responses – time domain specifications & steady state error.
Concept of stability – Routh's stability criterion – Root locus – effect of addition of poles and zeros.
Frequency domain analysis – Nyquist & Bode plots, gain margins and phase margin, lag, lead and lag-lead compensators and their design using Bode plot.
State space analysis of system: State space models, state transition matrix, relationship between state equations and transfer function, controllability and observability.

Nonlinear system: - characteristics, types of non-linearities, describing functions analysis – concept, singular points – focus, centre, node and saddle points – limit cycle.
Types of signals and systems, sampling process, sampling theorem, convolution of discrete time signals, analysis of LTI systems using ~~Z~~ transforms. DFT and FFT, Types of digital filters.

Module V : Electronics

BJT and FET amplifiers – biasing circuits, types of amplifiers, low frequency and high frequency considerations. Oscillators and feedback amplifiers, operational amplifier circuits and applications – simple active filters. VCO's and timers. Voltage regulators using linear IC's, combinational and sequential logic circuits – flip flops, counters, shift registers, TTL & CMOS logic families, memories – ROM, PROM, EPROM & RAM.
Schmitt trigger, multivibrators, sample and hold circuits, A to D and D to A converters, 8 bit and 16 bit microprocessor basics, architecture, programming and interfacing.
Thyristors, triacs, GTO's MOSFETS & IGBTS – principles of operation, triggering circuits, phase control rectifiers, bridge converters – fully controlled and half controlled, Inverters and choppers.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.